

DRAFT

75055
Ilmenite Basalt
949.4 grams



Figure 1: Photo of top, exterior surface of 75055, showing zap pits. NASA S73-15097. Sample is about 10 cm across.

Introduction

75055 is made up of three pieces chipped from the side of a large boulder on the rim of Camelot Crater. Following the concept of “overturned flap”, this sample may be from the deepest lava flow at Apollo 17, since Camelot Crater was the largest crater sampled (Wolfe et al. 1981). Together, the three pieces form a thin flat sample. The outside, exposed surface had micrometeorite craters (figure 1).

75055 is a medium-grained ilmenite basalt that appears to be quite similar to some of the Apollo 11 basalt samples. 75055, along with 75015 and 75035 from the same location, is slightly more aluminous and less titanium rich, than other Apollo 17 basalt samples (Rhodes et al. 1976).

The crystallization age has been determined to be 3.78 b.y. with a cosmic ray exposure age of about 80 m.y.

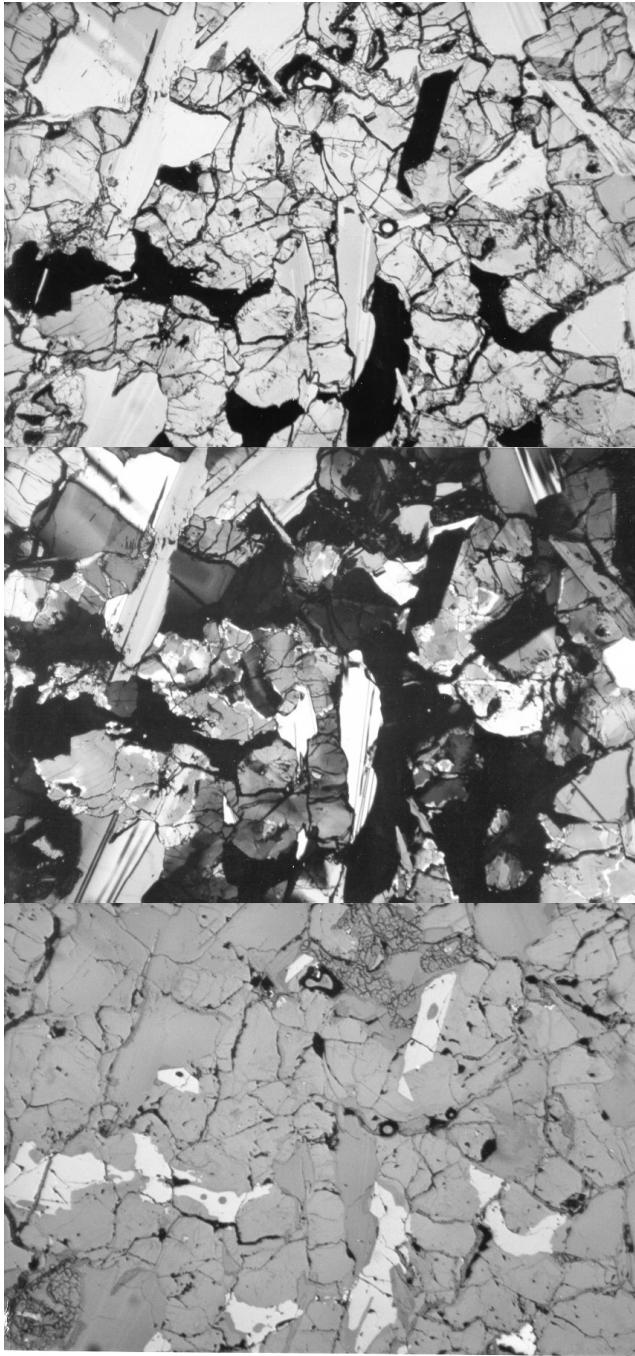


Figure 2: Photomicrographs of thin section 75055,47. Top is transmitted light, middle is with crossed polarizers and bottom is reflected light. NASA S79-27095 to 27097. Field of view is 2.5 mm.

Petrography

Kriedelbaugh and Weill (1973) gave the first report of the petrology of 75055 who give the average grain size as about 1 mm and describe the texture as ophitic (figures 2 and 4). Dymek et al. (1975) performed a detailed analysis of all minerals in 75055, combining them in the proportions of the mode to successfully

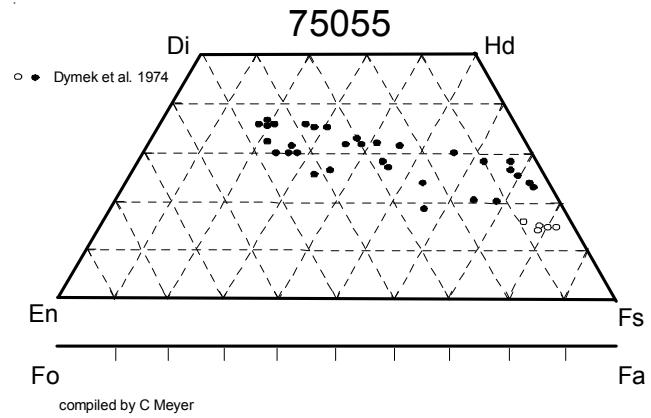


Figure 3: Pyroxene composition for 75055 (replotted from Dymek et al. 1975).

calculate the bulk sample composition (Table 1). Dymek et al. described the texture as medium- to fine-grained intergranular to subophitic. McGee et al. (1977) described the texture as coarse grained subophitic with tabular plagioclase (0.05 to 2 mm) intergrown with subhedral to anhedral pyroxene (0.05 to 0.8 mm) and ilmenite laths (0.4 to 1.4 mm). Observations indicate that plagioclase may have been one of the first phases to form, along with ilmenite, during crystallization.

The mesostasis between the major minerals contains silica, troilite, Fe metal, ulvöspinel, Ca phosphate and tranquillityite (Dymek et al. 1974).

Mineralogy

Olivine: none

Pyroxene: Pyroxene is chemically zoned from $\text{Wo}_{40}\text{En}_{44}\text{Fs}_{16}$ – $\text{Wo}_{16}\text{En}_3\text{Fs}_{81}$ (figure 3). Sector zoning is poorly defined (Dymek et al. 1974).

Plagioclase: Plagioclase is zoned (An_{91-72}) with increasing Fe/Mg along with increasing Na.

Ilmenite: Tabular plagioclase has a “swiss-cheese” like texture with glassy inclusions and embayed margins. Dymek et al. observed that one ilmenite was overgrown and resorbed by ulvöspinel.

Silica: Both cristobalite and tridymite are present in 75055 (Dymek et al. 1975). Cristobalite has the characteristic fine “mosaic” fracture pattern, while tridymite occurs as needles.



Figure 4: Photomicrograph of thin section of 75055. NASA S74-23074. Field of view is about 1.5 mm.

Chemistry

The chemical composition of 75055 is remarkably similar to low K, ilmenite basalts from Apollo 11 (figures 5 and 6). Dymek et al. (1974) noted the remarkable similarity to 10044.

Gibson et al. (1976) determined 2210 ppm S for 75055 (high).

Radiogenic age dating

Tatsumoto et al. (1973) and Tera et al. (1974) reported Rb/Sr isochron ages of 3.77 ± 0.06 b.y. and 3.83 ± 0.1 b.y. respectively, while Huneke et al. (1973) determined a more precise age of 3.78 ± 0.02 b.y. by the Argon plateau technique (figure 7). Kirsten et al. (1973) reported an age of 3.82 ± 0.05 b.y. by Ar/Ar. Birck et al. (1973) also reported 3.83 b.y. by Rb/Sr (quoted in Kirsten et al.)

Mineralogical Mode of 75055

	Brown et al. 1975	McGee et al. 1977	Dymek et al. 1975	Kriedelbaugh and Weill 73
Olivine				
Pyroxene	50.2	45-51	50	51.4
Plagioclase	28.6	29-35	33	29.1
Ilmenite	15.9	12-20	12.1	13.4
Silica	4.5	3-5	3.4	3
Mesostasis	0.8	1-2	1.5	3

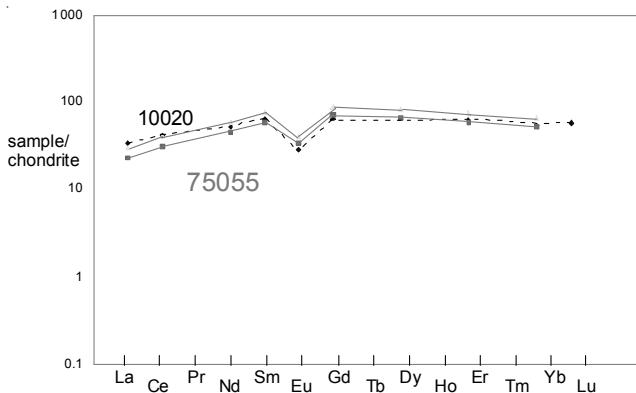


Figure 5: Normalized rare-earth-element diagram for 75055 (isotope dilution data by Shih et al. 1975) compared with Apollo 11 basalt 10020 (Wiesmann et al. 1975).

Tatsumoto et al. noted that the Pb isotopes in 75055 were very “similar to that of Apollo 11 low-K basalt.” Nunes et al. (1974), Tera et al. (1975abs) and Chen and Wasserburg (1980) also reported Pd data (figure 12). Unruh et al. (1983) determined the isotopic composition of Nd and Hf to obtain model ages.

Cosmogenic isotopes and exposure ages

Rancitelli et al. (1974) determined significant cosmic-ray-induced activity for ^{26}Al = 69 dpm/kg., ^{22}Na = 85 dpm/kg., ^{54}Mn = 139 dpm/kg., ^{56}Co = 210 dpm/kg., ^{7}Be = 140 dpm/kg., etc.

Turner et al. (1973) and Huneke et al. (1973) determined ^{38}Ar cosmic ray exposure ages of 90 and 95 m.y. respectively, which would be interpreted as the age of Camelot Crater. Kirsten et al. (1973) reported 85 m.y. (or 70 m.y. taking the geometry of the boulder into account).

Other Studies

75055 was used to determine the isotopic ratio of various elements. Niederer et al. (1980) determined the isotopic composition of Ti and Russell et al. (1975) determined Ca. Mayeda et al (1975) and Taylor and Epstein (1973) determined the isotopic composition of oxygen and silicon and Gibson et al (1975) determined sulfur. Nyquist et al. (1975) determined Sr.

Pearce et al. (1974) studied the magnetic properties of 75055.

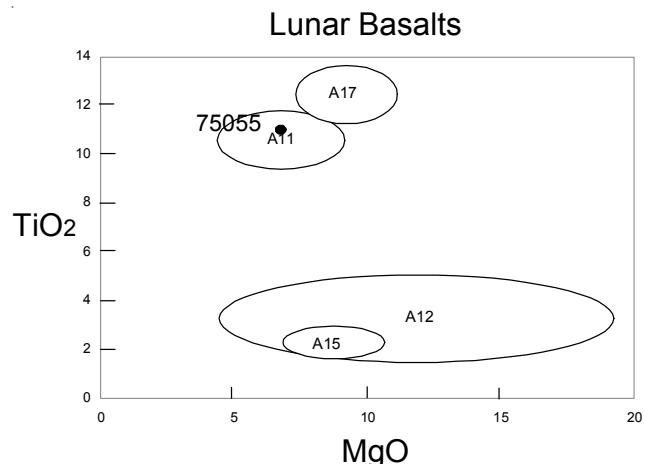


Figure 6: Composition for 75055 compared with other lunar basalts.

Hess et al. (1975) used 75055, or a synthetic mix with 75055 composition, to determine when liquid immiscibility occurs during crystallization (~1000 deg C). Gamble and Taylor (1979) used 75055 to study kinetic effects on crystal-liquid portioning in augite.

Processing

Neal and Taylor (1993) give a fine summary of the research on 75055 in their re-catalog of Apollo 17 basalts.

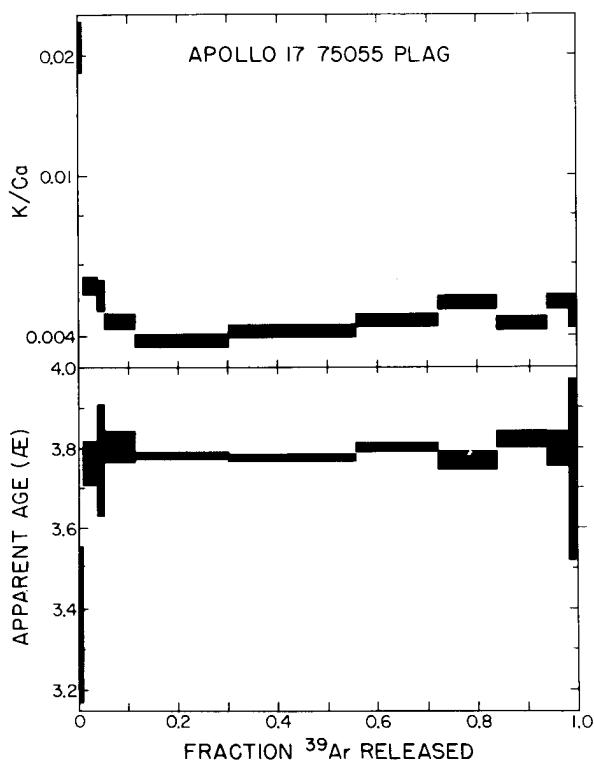


Figure 7: Argon plateau diagram for plagioclase from 75055 (Huneke et al. 1973).

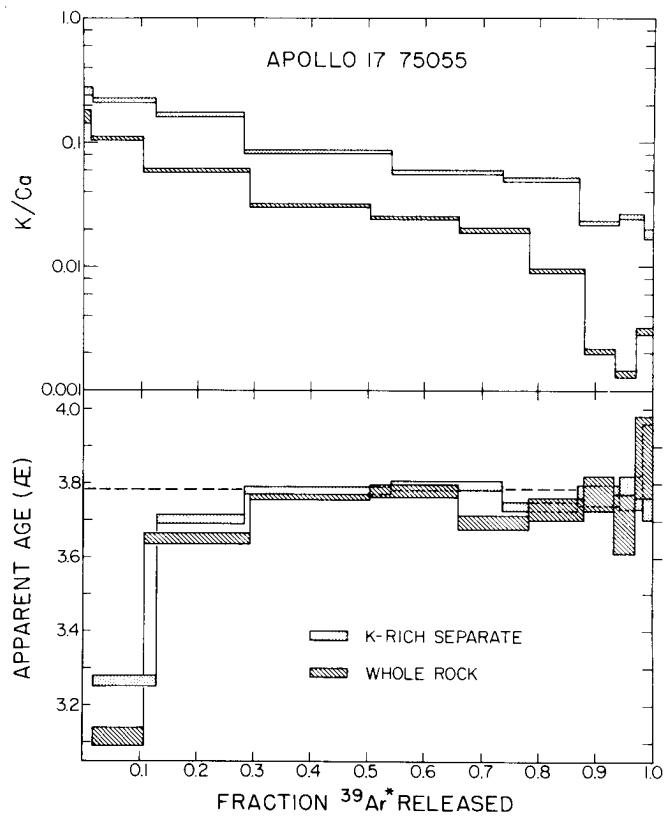


Figure 8: Argon plateau diagram for whole rock and "K-rich separate" 75055 (Huneke et al. 1973).

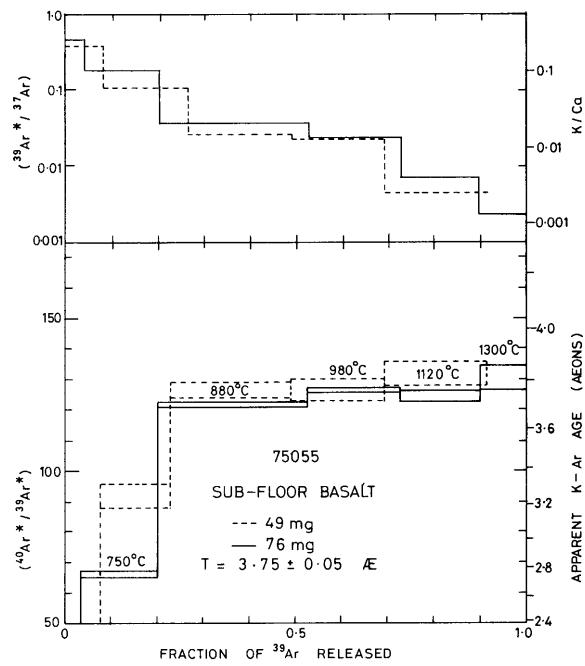


Figure 9: Argon release plateau for 75055 (Turner and Cadogan 1973).

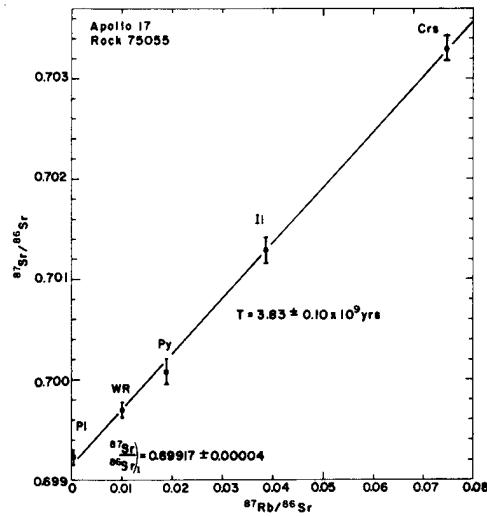


Figure 10: Rb/Sr mineral isochron for 75055 (Tatsumoto et al. 1973).

Summary of Age Data for 75055

	Rb/Sr	Ar/Ar
Tatsumoto et al. 1973	3.83 ± 0.10 b.y.	
Tera et al. 1974	3.77 ± 0.06	
Huneke et al. 1973		3.82 ± 0.05
Turner et al. 1973		3.78 ± 0.02
Kirsten et al. 1973		3.76 ± 0.05
		3.82 ± 0.05

Table 1a. Chemical composition of 75055.

reference weight	LSPET73	Garg76	Rancitelli 74 405 g	Boynton75 473 mg	Shih 75 Nyquist 75	Rhodes76	Dymek74
SiO ₂ %	41.27	(b)				39.93	(b) 41.51 (e)
TiO ₂	10.17	(b)		10.4	(a)	11.41	(b) 10.48 (e)
Al ₂ O ₃	9.75	(b)		10.77	(a)	9.58	(b) 10.28 (e)
FeO	18.24	(b) 20.3	(a)	16.8	15.6 (a)	17.77	(b) 17.86 (e)
MnO	0.29	(b)		0.25	(a)	0.27	(b) 0.25 (e)
MgO	6.84	(b)				7.26	(b) 5.75 (e)
CaO	12.3	(b)		12.6	11.62 (a)	12.4	(b) 12.83 (e)
Na ₂ O	0.44	(b)		0.46	0.42 (a)	0.42	(b) 0.58 (e)
K ₂ O	0.09	(b)	0.078	(c)	0.056	0.075 (d)	0.06 (b) 0.07 (e)
P ₂ O ₅	0.07	(b)				0.06	(b) 0.05 (e)
S %	0.19	(b)				0.14	(b) 0.03 (e)
<i>sum</i>							
Sc ppm		83.3	(a)	79	75 (a)	82.7	(d)
V							
Cr	1847	(b) 1660	(a)	1950	1840 (a)	1857	(d) 1748 (b) 2670 (e)
Co		16.7	(a)	16	13 (a)	14.5	(d)
Ni	2	(b)					
Cu							
Zn	7	(b)					
Ga							
Ge ppb							
As							
Se							
Rb	0.7	(b)			0.482	0.685 (d)	
Sr	209	(b)			180	201 (d)	
Y	112	(b)					
Zr	272	(b) 362	350 (a)				190 (e)
Nb	25	(b)					
Mo							
Ru							
Rh							
Pd ppb							
Ag ppb							
Cd ppb							
In ppb							
Sn ppb							
Sb ppb							
Te ppb							
Cs ppm							
Ba					66	86.4 (d)	
La				5.7	(a) 5.39	7.14 (d)	
Ce	49.6	(a)		26	27 (a)	24.5	(d)
Pr							
Nd					20.7	27.1 (d)	
Sm				9.6	9 (a) 8.8	11.3 (d)	
Eu	2.39	(a)		2	1.86 (a)	2.27 (d)	
Gd					1.91 13.9	17.5 (d)	
Tb	3	(a)		2.1	2.5 (a)	16.1	20.1 (d)
Dy							
Ho						9.54	11.9 (d)
Er							
Tm							
Yb				9.1	9.2 (a)	8.68	10.9 (d)
Lu	1.9	(a)		1.4	1.24 (a)		
Hf	11.6	11.7 (a)		7.4	7 (a)		
Ta							
W ppb							
Re ppb							
Os ppb							
Ir ppb							
Pt ppb							
Au ppb							
Th ppm			0.4 (c)			0.44 (d)	
U ppm			0.1 (c)			0.13 (d)	

technique: (a) INAA, (b) XRF, (c) radiation counting, (d) IDMS, (e) elec. probe

Table 1b. Chemical composition of 75055.

reference	Wolf 79	Hughes 85	Nunes74	Tera 74	Unruh84	Chen80
weight	51 mg					
SiO ₂ %						
TiO ₂						
Al ₂ O ₃						
FeO						
MnO						
MgO						
CaO						
Na ₂ O						
K ₂ O				0.0725	(d)	
P ₂ O ₅						
S %						
sum						
Sc ppm						
V						
Cr						
Co						
Ni	<4	(f)				
Cu						
Zn	1.53	(f)				
Ga						
Ge ppb	2.54	(f)				
As						
Se	119	(f)				
Rb	0.538	(f)		0.796	(d)	
Sr			188		(d)	
Y						
Zr		150	(a)			
Nb		6.9	(a)			
Mo						
Ru						
Rh						
Pd ppb	1.1	(f)				
Ag ppb	0.76	(f)				
Cd ppb	1.92	(f)				
In ppb	0.57	(f)				
Sn ppb	<40	(f)				
Sb ppb	0.99	(f)				
Te ppb	<2	(f)				
Cs ppm	0.019	(f)				
Ba						
La						
Ce						
Pr						
Nd			25.2	(d)		
Sm			10.6	(d)		
Eu						
Gd						
Tb						
Dy						
Ho						
Er						
Tm						
Yb						
Lu			1.66	(d)		
Hf		6.9	(a)	9.61	(d)	
Ta						
W ppb						
Re ppb	0.0031	(f)				
Os ppb	<0.02	(f)				
Ir ppb	0.035	(f)				
Pt ppb						
Au ppb	0.007	(f)				
Th ppm			0.4472		(d)	
U ppm			0.1359		(d)	
technique:	(a) INAA, (d) IDMS, (f) RNAA			43 ng		

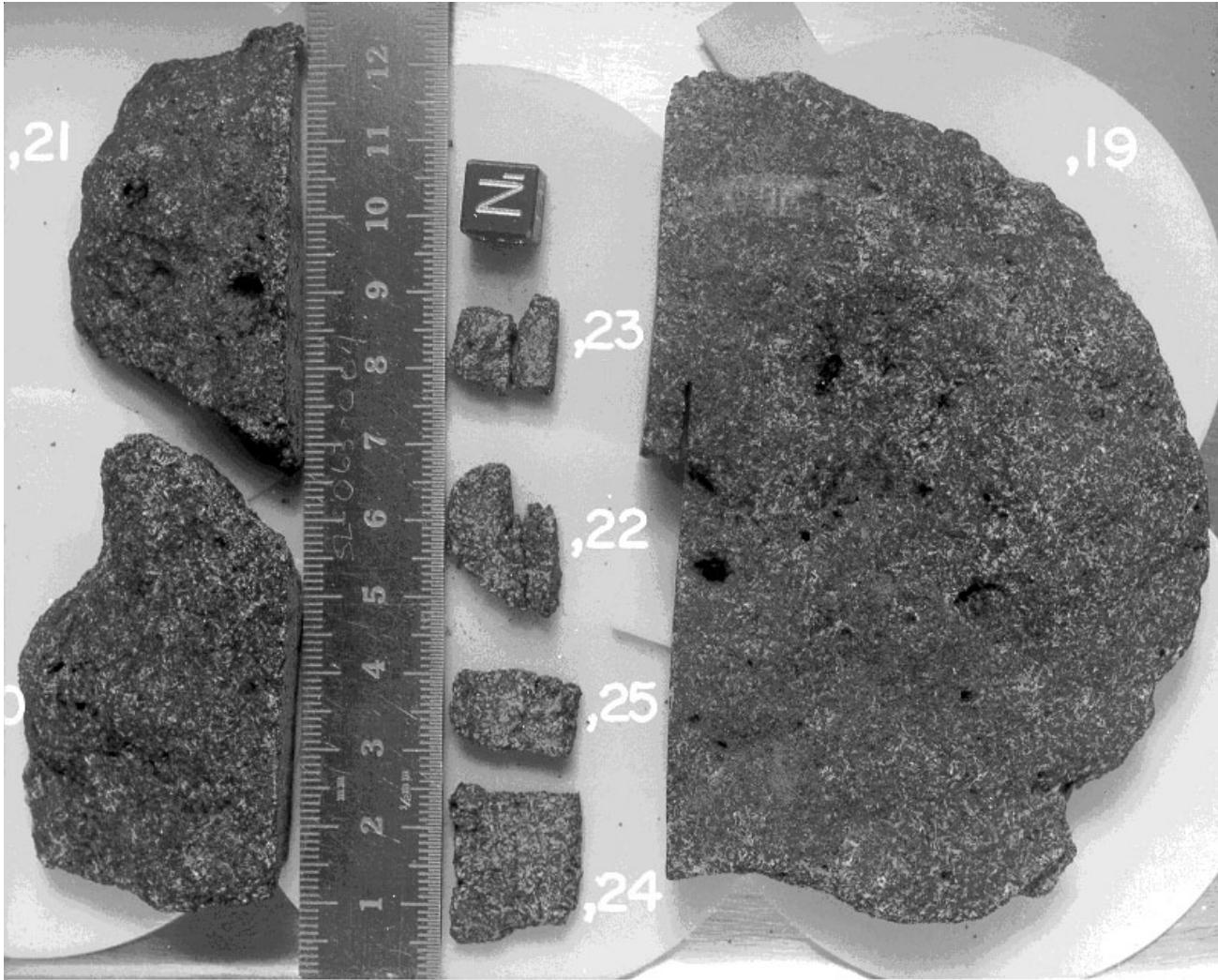


Figure 11: Photo of 75075,2. NASA S74-17400.

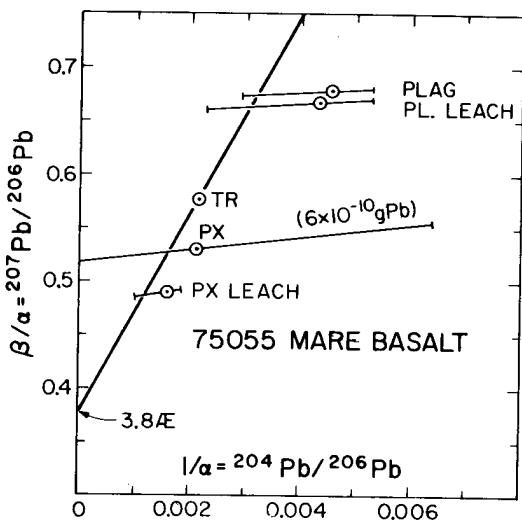


Figure 12: Pb data for mineal separates and leaches of 75055 (from Tera et al. 1975 abs).

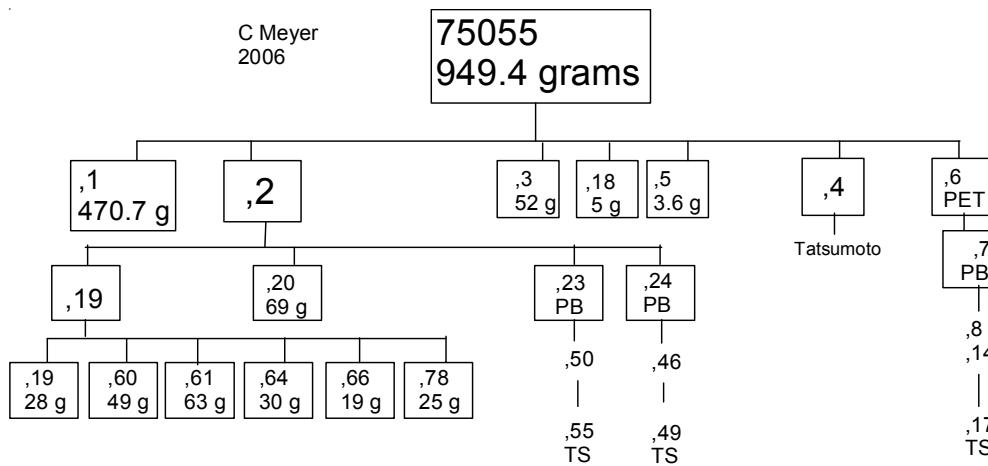


Table 2

	U ppm	Th ppm	K ppm	Rb ppm	Sr ppm	Nd ppm	Sm ppm	technique
Nunes et al. 1974	0.1359	0.4472						idms
Shih et al. 1975	0.13	0.44		0.685	201	27.1	11.3	idms
				0.482	180	20.7	8.8	idms
Rancitelli et al. 1973	0.1	0.4	650					counting
Wolf et al. 1979	0.128							RNAA
Unruh et al. 1983						25.2	10.6	idms